

NOVEMBER 2019



**WIM #37
I-94, MP 200.1
OTSEGO, MN**

**MONTHLY
REPORT**



Your Destination...Our Priority



WIM Site Location

WIM #37 is located on I-94 near Otsego in Wright county. The WIM is located only on the westbound (WB) side of I-94, meaning that all data mentioned in this report pertains to WB traffic only (Lanes 1 and 2).

System Operation

WIM #37 was operational for the entire month of November 2019. Volume was computed using all monthly data.

System Calibration

WIM #37 was most recently calibrated on 2016-08-01. Table 1 summarizes the front axle weights of class 9s by lane ¹. Figure 1 shows the distribution of gross vehicle weights (GVW) in the Class 9s at this site for the last 12 months ². Figure 2 depicts the average front axle weight as a percent difference from the first full month following calibration.

Summary of Volume Statistics

Total Monthly Volume: 889379 | Passenger Vehicles: 769306 | Heavy Commercial Vehicles: 120073

Monthly Average Daily Traffic (MADT): 29646 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 4002

See Table 2 for vehicle class breakdown

Passenger Vehicles (PVs) and Heavy Commercial Vehicles (HCVs)

Volume trends. WB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Wednesdays (see Figure 3 and 4).

Passenger Vehicles (PVs)

Volume trends. On an average 24-hour day (see Figure 5), WB PVs generally reached peak volume levels between 03 PM and 05 PM.

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling WB typically reached peak volume levels between 03 PM and 05 PM. See Figure 6. Out of all HCVs, the two highest traffic volumes were generated by Class 9's and Class 5's.

Overweight HCVs

Volume trends. Of a total of 120073 HCVs, 9045 of them were overweight ³. These overweight HCVs contributed to 1% of total monthly volume, and 7.7% of total monthly HCV volume. WB overweight vehicles typically reached highest numbers on Wednesdays, with lowest volumes reported on Sundays See Figure 3 .

The top two overweight violators by class were the class 9 and class 10 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours (see Figure 7 & 8).

Figure 9 shows the number of vehicles exceeding 88,000 pounds that crossed the WIM over the last 12 months. The highest number of 88,000+ vehicles within the last 12 months occurred in October.

WIMs are currently used as a screening tool for weight enforcement, and it is estimated that the WIM scales can measure gross vehicle weights (GVW) within 90-95% of static weight scale measurements. Due to the possibility of measurement error, vehicles exceeding 10% of their legal weight limits (or 1.1 times their legal weight limits) are considered overweight in this report ⁴.

Using normal load limits ,3189 WB vehicles exceeded 88,000 pounds (2693 vehicles were Class 9's; 298 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from November 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9's and 10's in November 2019. Data suggests that there were greater numbers of fully_loaded Class 9's than empty Class 9's traveling WB Data also suggests that there were more NA Class 10's than NA traveling in the WB direction.

Freight Totals. A total of 992830 tons of freight was recorded to have crossed the WIM. See Table 4 and Figure 11 for more freight information.

####**Infrastructure Considerations Bridge.** Bridge No. 86817 is approximately 1.2 miles east of WIM #37 and Bridge No. 86813 is approximately 4.7 miles west of WIM #37. WIM #37 recorded a total of 889379 vehicles with a combined GVW of 9126008 kips (1 kip = 1,000 pounds = 0.5 tons) in November 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 92128 equivalent single axle loads (ESALs) passed over the pavement at this site. In particular, 71% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 43% of total GVW observed this month). See Table 6 and Figures 14-15 for more information on ESALs (Table 6 also provides flexible ESAL factors for each vehicle class using a terminal serviceability of 2.5 and a structural number of 5).

#####WIM monthly reports can be found at:

<http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html> MnDOT's vehicle classification scheme and vehicle class groupings for traffic forecasting can be found at: <http://www.dot.state.mn.us/traffic/data/data-products.html#weight>

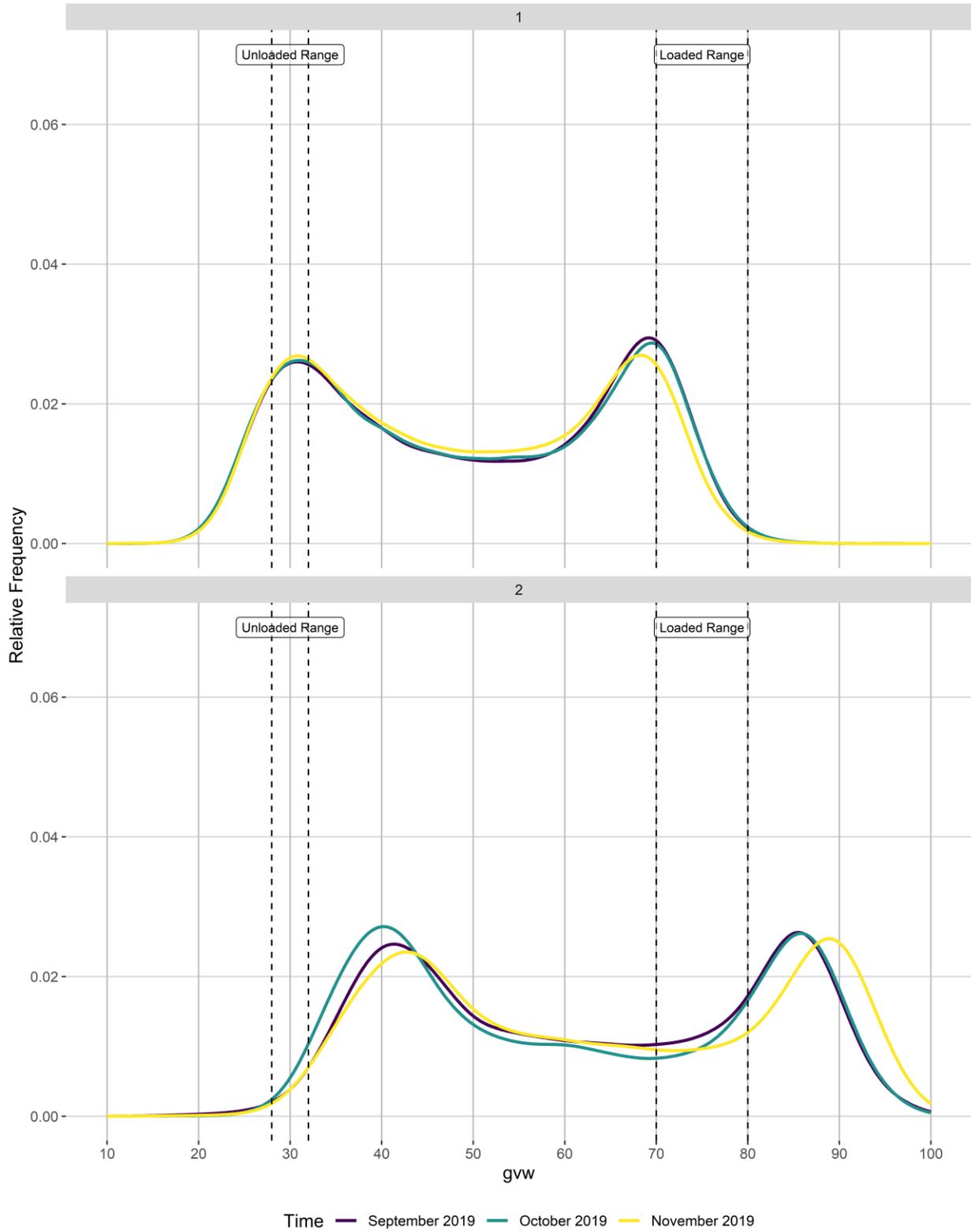
- ¹ Front axle weights of Class 9s are monitored on a monthly basis to assure performance between calibrations. The current goal of the WIM scale calibration is to have each individual axle weight stay within a range of +/-9% of baseline calibration values
- ² Previous WIM research indicates that unloaded Class 9s typically weigh 28-32 kips, while loaded Class 9s generally fall in the 70-80 kip range. More recent data from

several WIM sites suggests that the unloaded Class 9 range may have moved a little higher over time (due to increased presence of sleeper cabs, etc.), although these ranges are also thought to be site-specific.

- ³ An HCV is considered overweight during normal load limits in this report if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 80,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 20,000 pounds; tandem axles spaced 8' or less = 34,000 pounds; tridem axles spaced 9' or less = 43,000 pounds; quad axles spaced 13' or less = 51,000 pounds). Monthly reports use this standard regardless of the time of year however, the Winter Load Increase (WLI) allows a 10% across the board increase in axle and gross vehicle weights without a permit on US, state routes, and county roads. An HCV is considered overweight during Winter Load Increase(WLI) if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 88,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 22,000 pounds; tandem axles spaced 8' or less = 37,400 pounds; tridem axles spaced 9' or less = 47,300 pounds; quad axles spaced 13' or less = 56,100 pounds). An overweight HCV is only included once in the overweight volume calculations regardless of how many of the aforementioned conditions are violated. For information on MN weight limit dates and statutes:
http://www.mrr.dot.state.mn.us/research/seasonal_load_limits/sllindex.asp
- ⁴ For example, Class 9s and 10s can legally have gross vehicle weights up to 80,000 lbs (with the exception of permitted loads) during normal load limits. To account for measurement error on the WIM scales, those exceeding 10% of the legal GVW maximum (or 1.1 times the legal GVW) should be screened (e.g., 80,000 lbs + 8,000 lbs = 88,000 lbs). Similarly during WLI vehicles weighing 96,800 lbs should be screened.

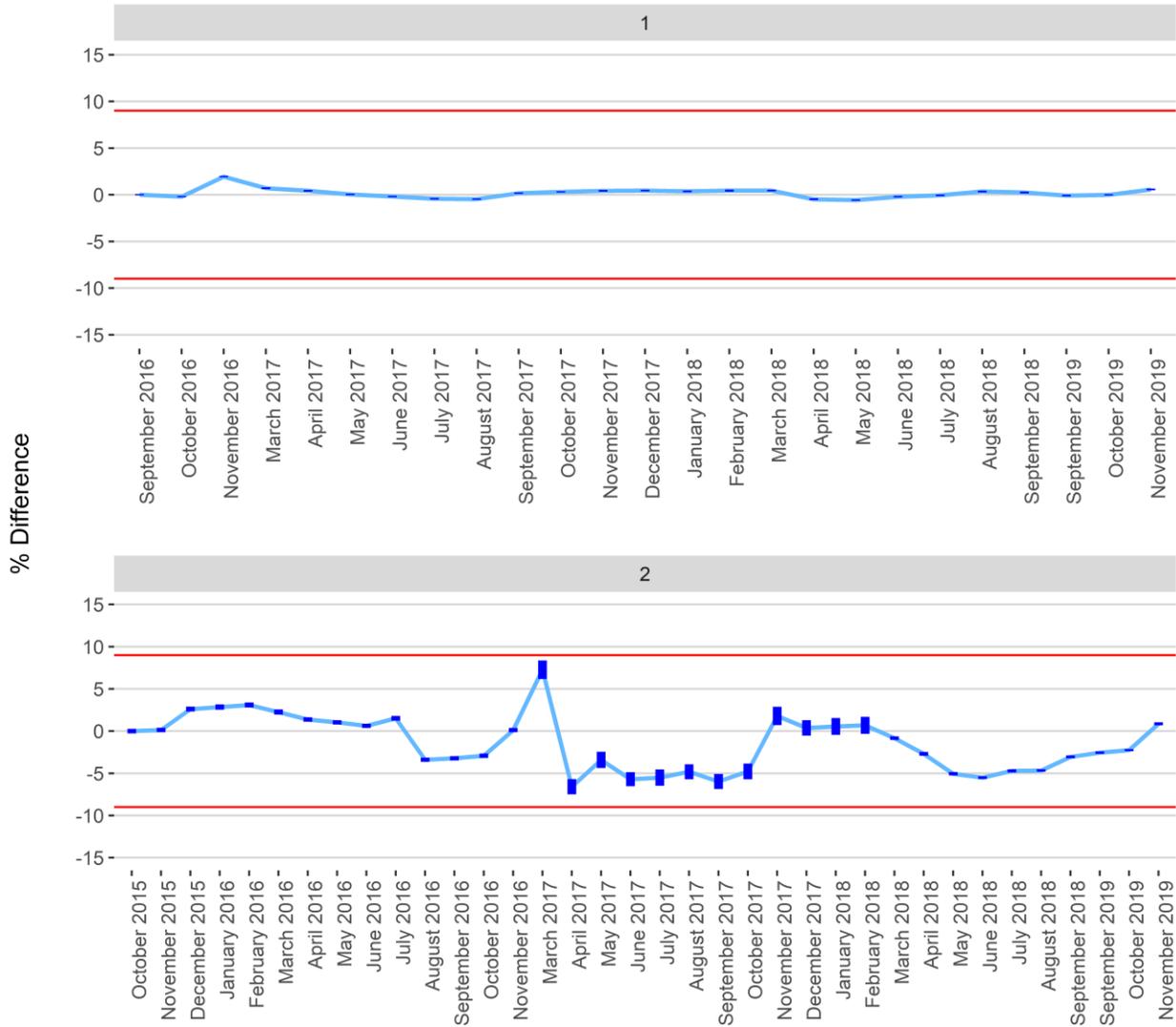
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Figure 1 - Monthly Class 9 GVW Histogram



Months that have not passed QC parameters are not displayed

Figure 2 - Percent Difference of Front Axle Weight from Last Calibration (+/- 95% CI)



Months that have not passed QC parameters are not displayed

Figure 2 - Average Vehicle Volume vs. Day of the Week

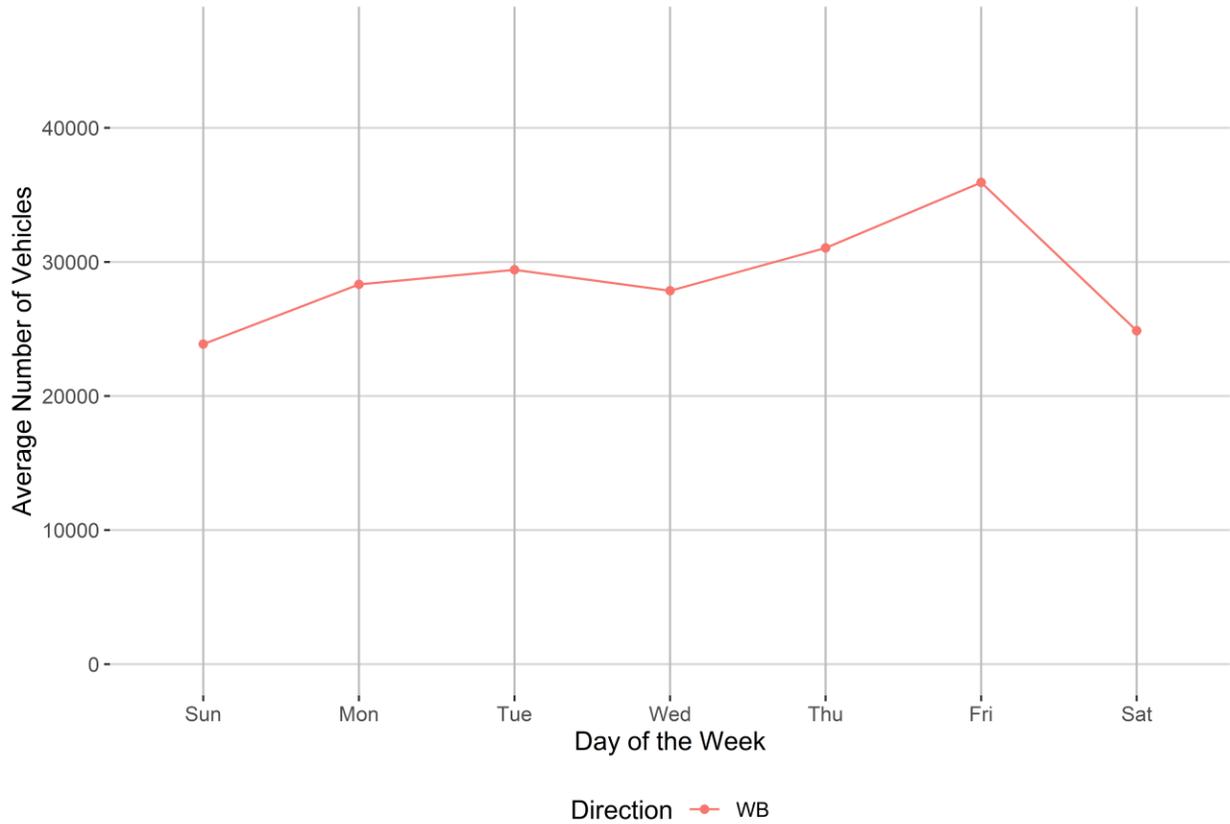


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

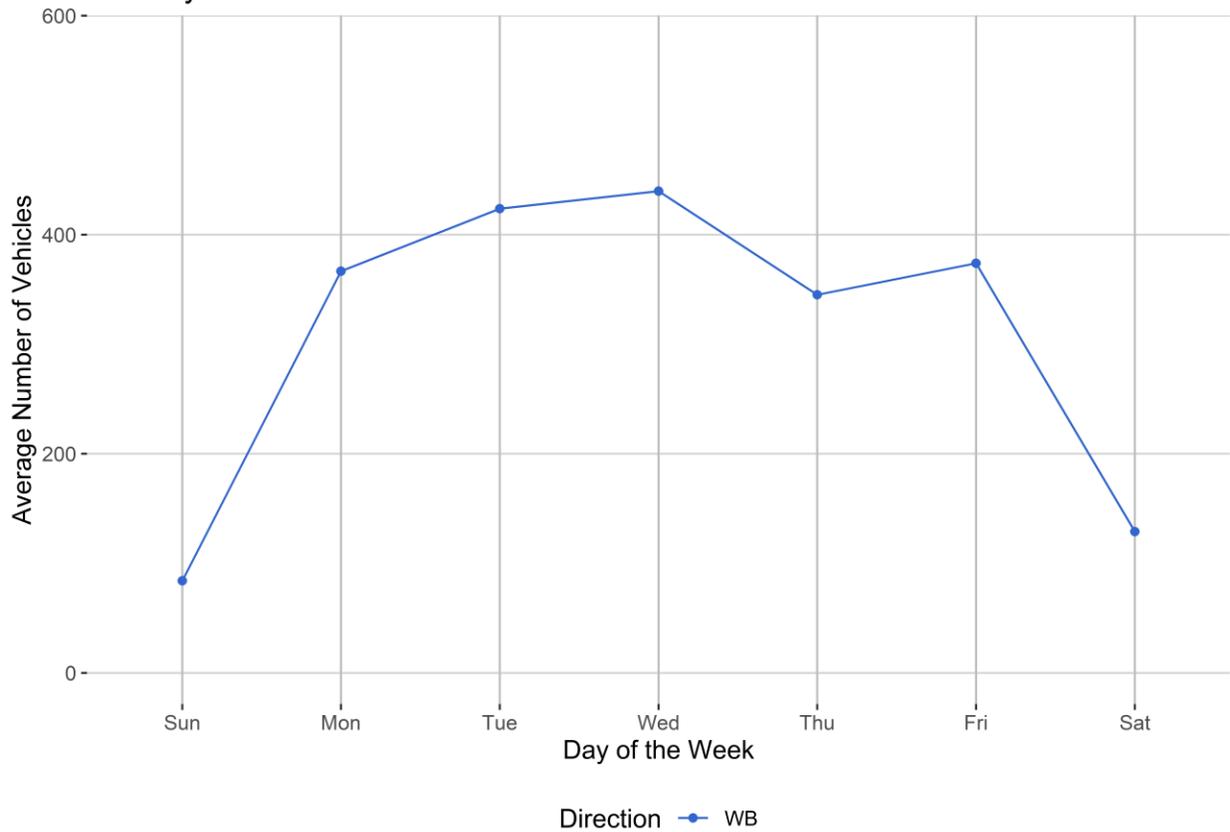


Figure 4 - Passenger Vehicles vs. Hour of the Day

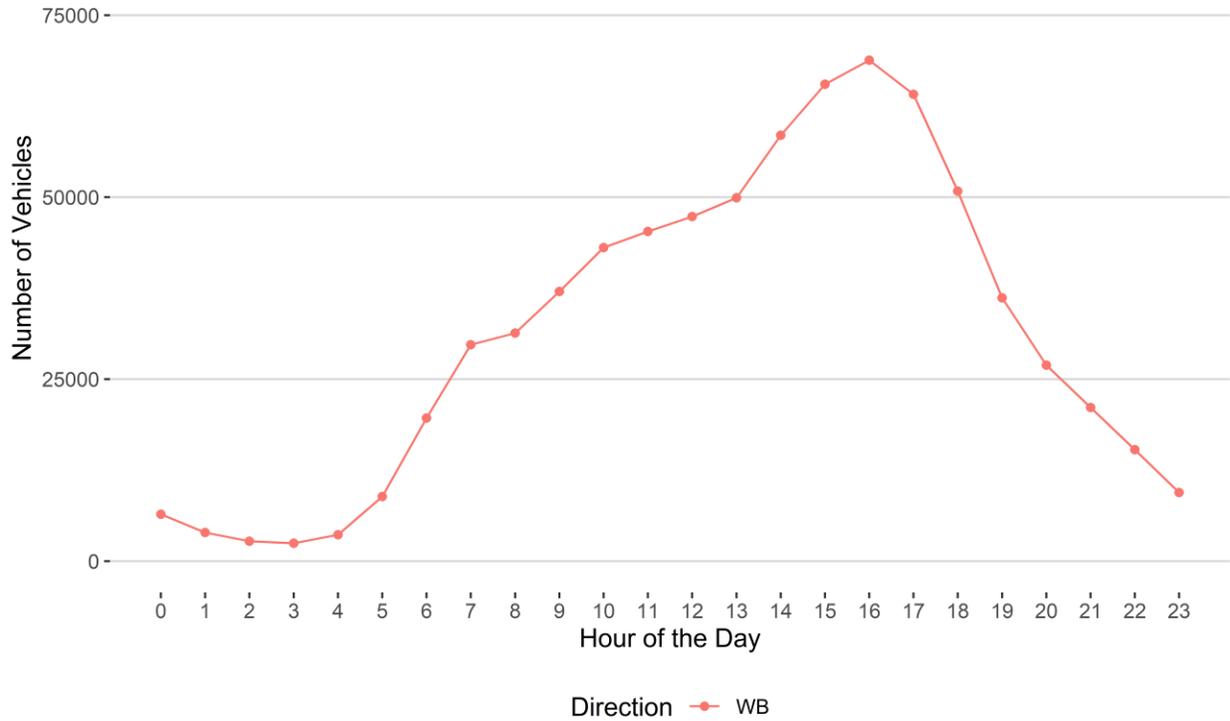


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

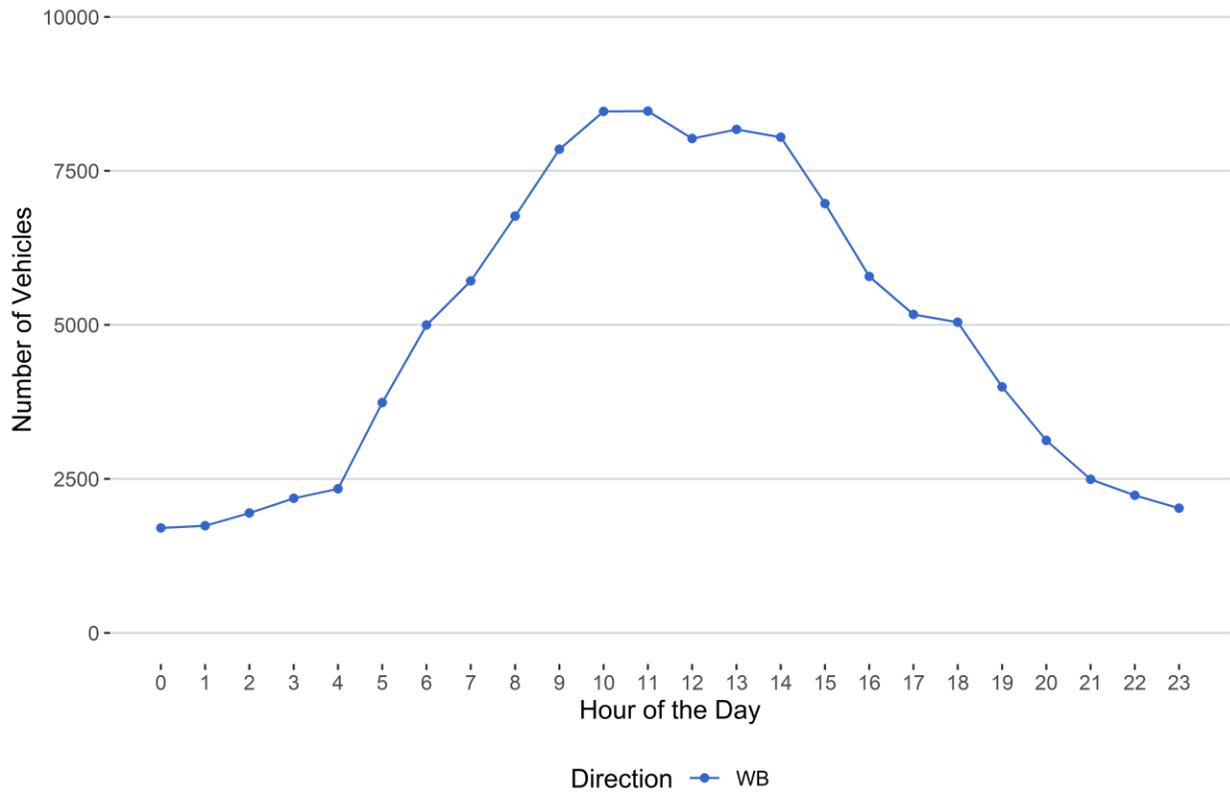


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

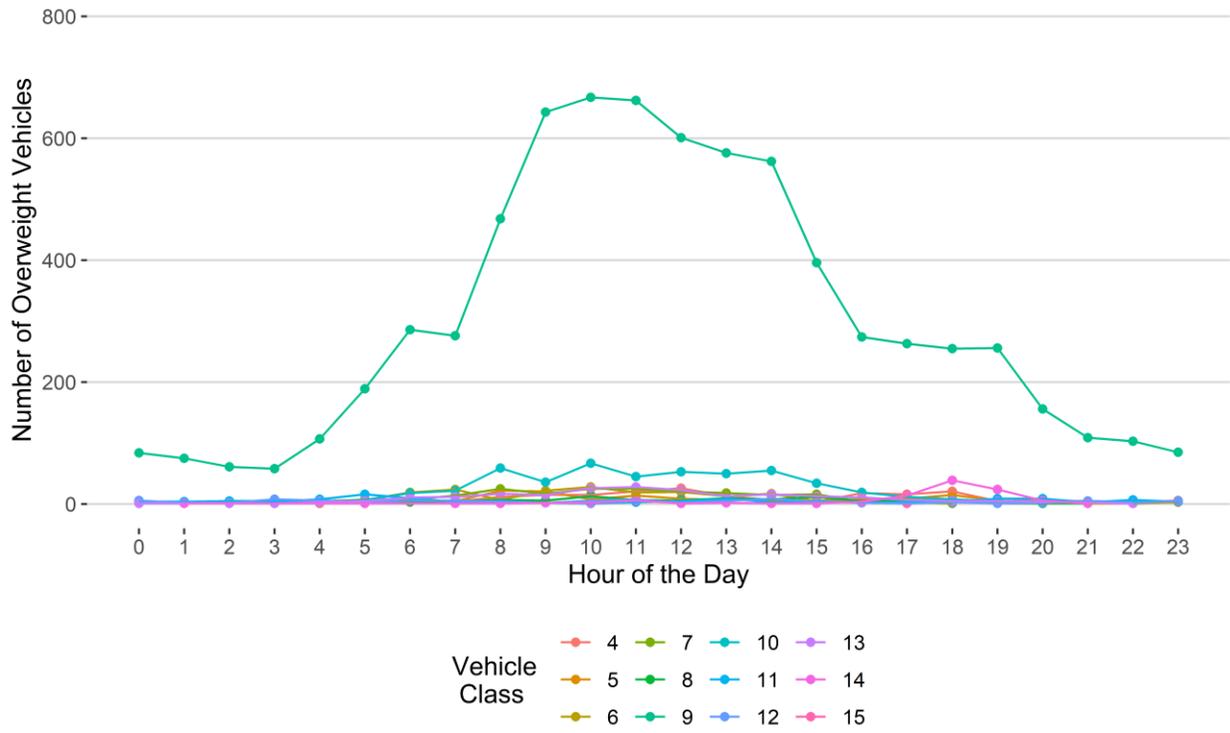


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

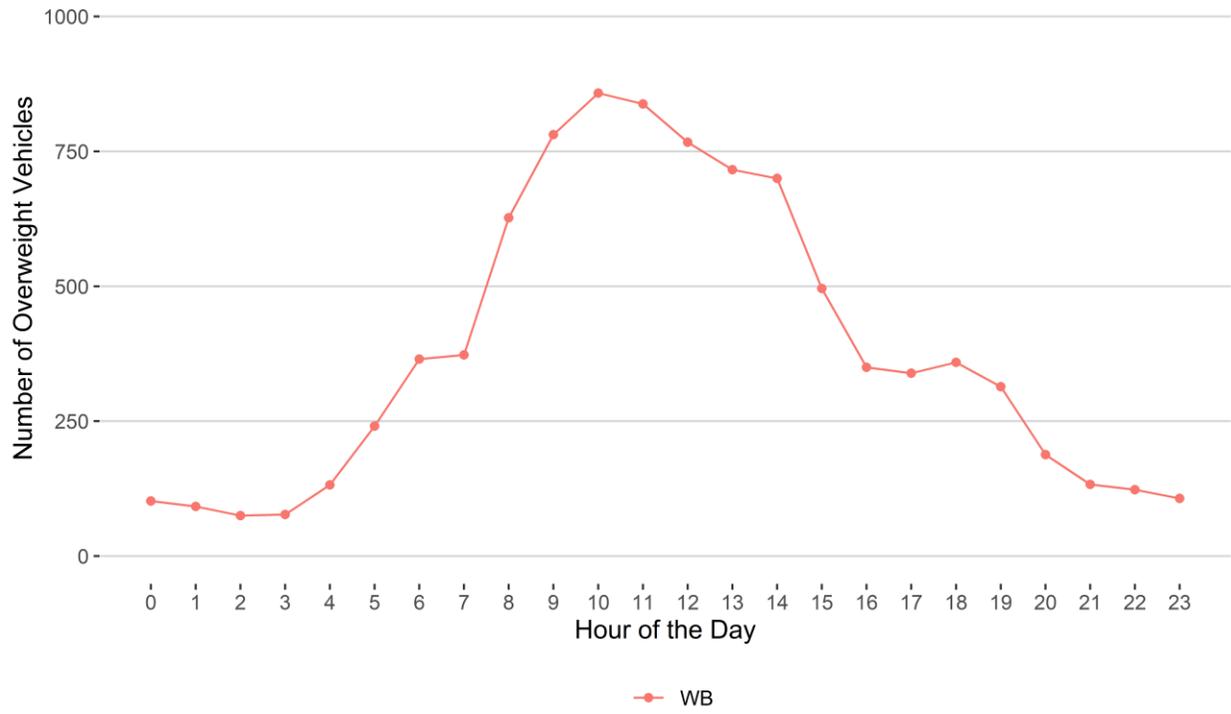
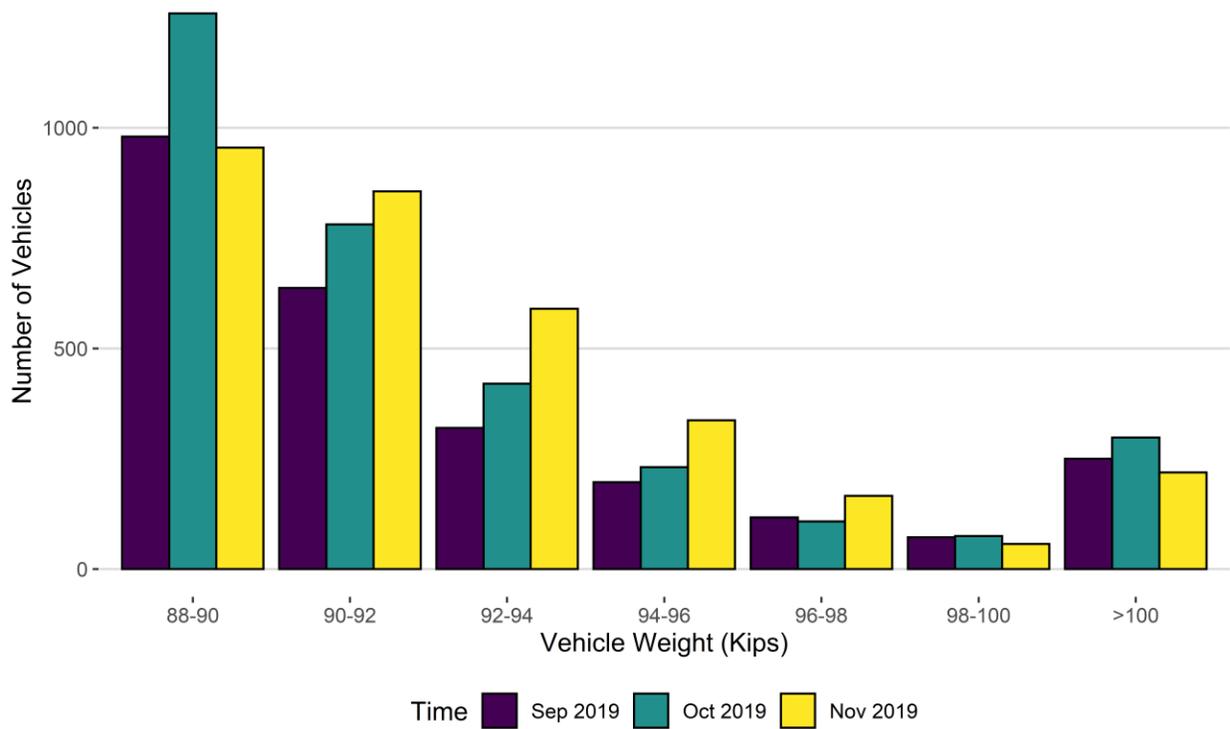


Figure 8 - Histogram of Vehicles Over 88,000 Pounds for Current Month



<i>Vehicle Weights (Kips)</i>	<i>Sep 2019</i>	<i>Oct 2019</i>	<i>Nov 2019</i>
88-90	980	1259	955
90-92	637	781	856
92-94	320	420	590
94-96	197	231	337
96-98	117	108	166
98-100	72	75	57
>100	250	298	219
Total	2573	3172	3180

Figure 8 - Class 9's and 10's by Direction vs Gross Vehicle Weight

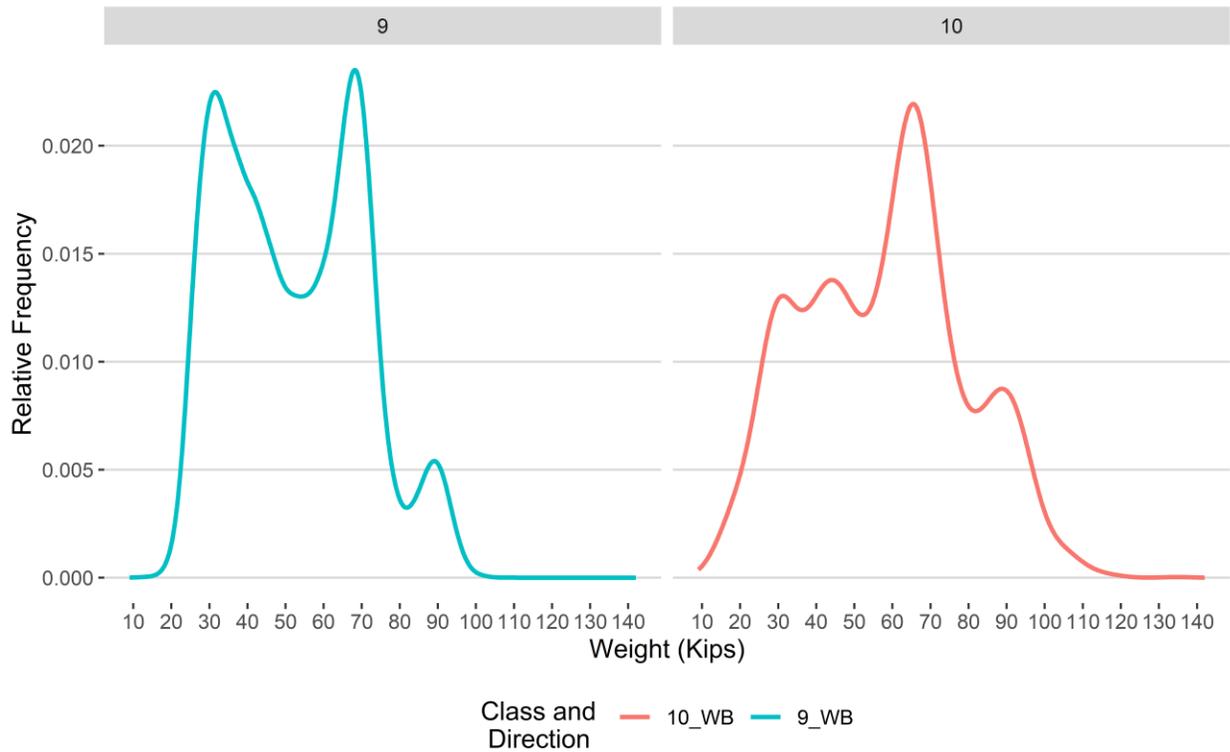


Figure 9 - Freight Percentage by Direction and Class

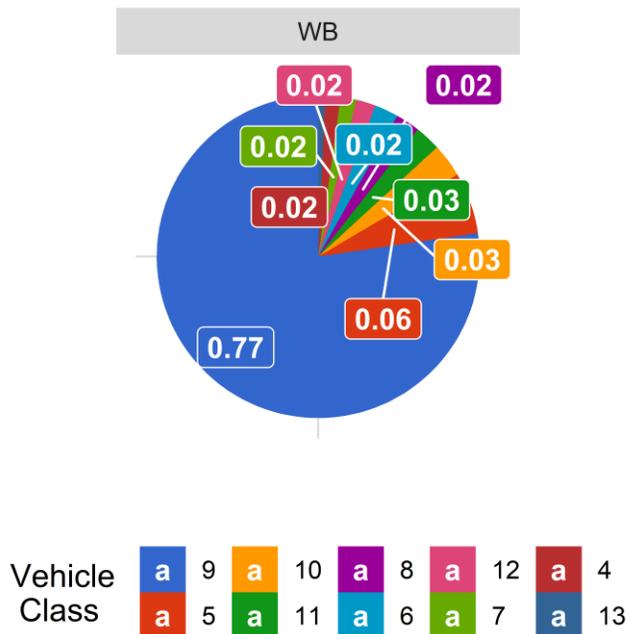


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

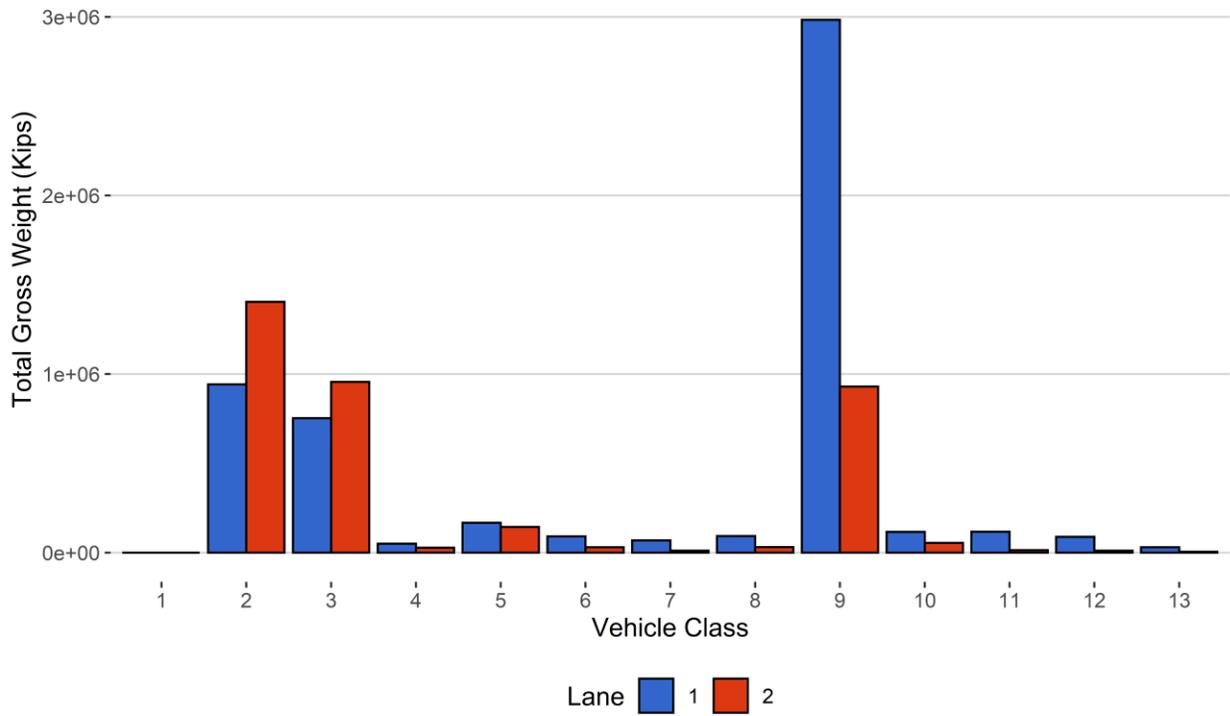


Figure 11 - Total Gross Vehicle Weight t

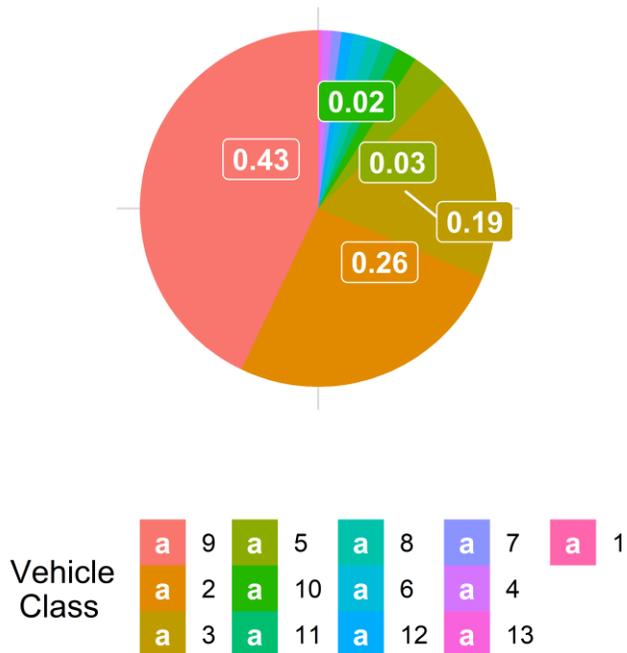


Figure 12 - Total ESALs by Class and Lane

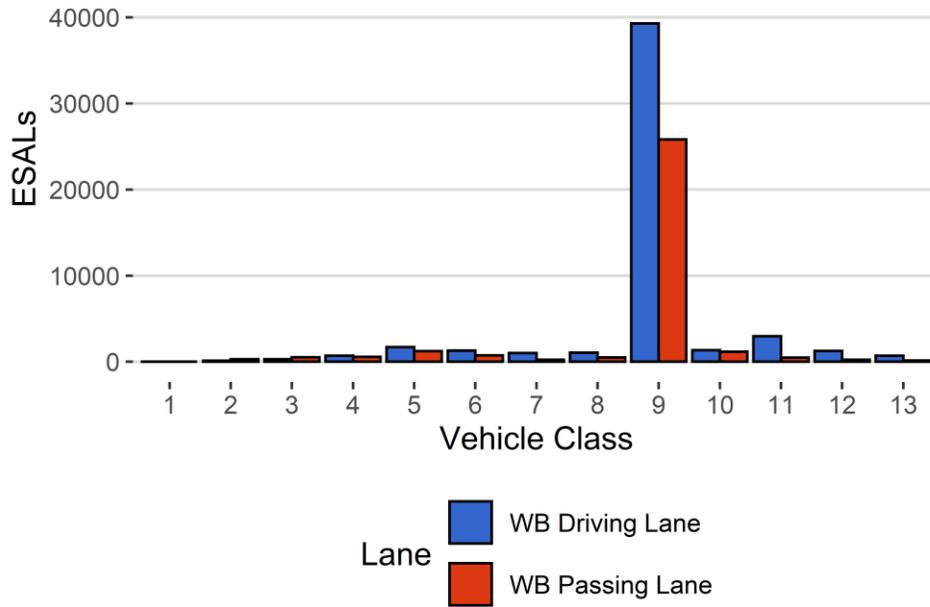


Figure 13 - ESALs by Class

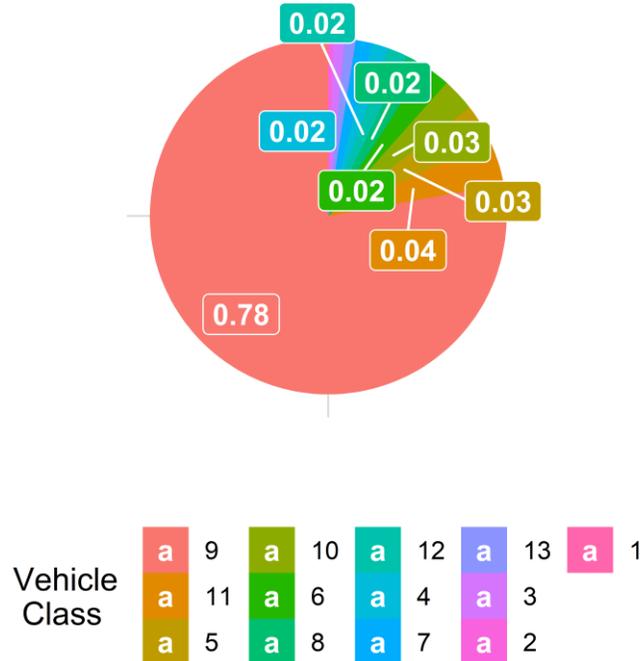


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
October 2015	NA	NA	12.62	0.00
November 2015	NA	NA	12.63	0.13
December 2015	NA	NA	12.95	2.61
January 2016	NA	NA	12.98	2.85
February 2016	NA	NA	13.01	3.09
March 2016	NA	NA	12.90	2.25
April 2016	NA	NA	12.79	1.38
May 2016	NA	NA	12.75	1.03
June 2016	NA	NA	12.70	0.61
July 2016	NA	NA	12.81	1.51
August 2016	NA	NA	12.19	-3.40
September 2016	10.50	0.00	12.21	-3.22
October 2016	10.48	-0.20	12.25	-2.92
November 2016	10.70	1.94	12.63	0.12
March 2017	10.57	0.70	13.54	7.27
April 2017	10.54	0.42	11.79	-6.60
May 2017	10.50	0.04	12.19	-3.41
June 2017	10.48	-0.19	11.90	-5.71
July 2017	10.45	-0.42	11.92	-5.51
August 2017	10.45	-0.47	12.01	-4.82
September 2017	10.52	0.16	11.86	-5.97
October 2017	10.53	0.30	12.02	-4.78
November 2017	10.54	0.42	12.84	1.79
December 2017	10.55	0.44	12.67	0.37
January 2018	10.54	0.36	12.69	0.55
February 2018	10.55	0.44	12.70	0.68
March 2018	10.55	0.45	12.51	-0.83
April 2018	10.45	-0.48	12.28	-2.69
May 2018	10.44	-0.57	11.98	-5.06
June 2018	10.48	-0.21	11.92	-5.52
July 2018	10.49	-0.06	12.02	-4.72
August 2018	10.54	0.35	12.03	-4.67
September 2018	10.52	0.24	12.23	-3.05
September 2019	10.49	-0.09	12.30	-2.55
October 2019	10.50	-0.01	12.33	-2.26
November 2019	10.56	0.56	12.73	0.86

Table 2 Vehicle Classification Data

<i>Vehicle Class</i>	<i>Monthly Average Daily Volume</i>	<i>Monthly Total Volume</i>	<i>Monthly Total Volume Percentage</i>	<i>Monthly Total Overweight Vehicles</i>	<i>Monthly Total Overweight Percentage</i>
1	0	2	0	0	0
2	17347	520398	58.5	0	0
3	8297	248906	28	0	0
4	97	2901	0.3	205	2.3
5	773	23196	2.6	169	1.9
6	135	4060	0.5	209	2.3
7	51	1526	0.2	185	2
8	140	4208	0.5	97	1.1
9	2566	76986	8.7	7212	79.7
10	101	3025	0.3	528	5.8
11	71	2139	0.2	125	1.4
12	54	1614	0.2	101	1.1
13	14	417	0	214	2.4
TOTAL	29646	889379	100	9045	100

Table 3 Top 10 Gross Vehicle Weight, Class 9 and 10

<i>Date</i>	<i>Day of Week</i>	<i>Time</i>	<i>Vehicle Class</i>	<i>Direction</i>	<i>Lane</i>	<i>GVW (lbs)</i>
2019-11-14	Thursday	01:08:57	9	WB	2	142.03
2019-11-01	Friday	10:22:58	10	WB	2	134.78
2019-11-03	Sunday	01:26:45	9	WB	2	132.46
2019-11-17	Sunday	16:09:44	9	WB	1	121.41
2019-11-12	Tuesday	10:19:56	10	WB	2	118.1
2019-11-16	Saturday	18:49:23	10	WB	1	117.87
2019-11-03	Sunday	00:47:06	10	WB	2	115.25
2019-11-20	Wednesday	08:41:00	9	WB	1	115.07
2019-11-06	Wednesday	07:39:33	10	WB	2	114.44
2019-11-13	Wednesday	10:38:39	10	WB	2	113.96

Table 4 Freight Summary

<i>Vehicle Class</i>	<i>Direction</i>	<i>Weight of Empty Vehicle (Kips)</i>	<i>Total Number of Vehicles</i>	<i>Number of Empty Vehicles</i>	<i>Percentage of Empty Vehicles</i>	<i>Total Weight of Vehicles with Freight (Kips)</i>	<i>Total Weight of Empty Vehicles (Kips)</i>	<i>Total Weight of Freight (Tons)</i>
4	WB	15	2827	353	12.5	72996	4672	17943
5	WB	8	22602	1164	5.1	302842	8308	65669
6	WB	19	3956	291	7.4	115908	5027	23137
7	WB	11.5	1487	2	0.1	79525	20	31224
8	WB	31	4100	2268	55.3	71231	52142	7219
9	WB	33	75015	14110	18.8	3511160	401552	750647
10	WB	33.5	2948	488	16.6	157358	13061	37474
11	WB	36.5	2084	37	1.8	129494	1159	27389
12	WB	36.5	1573	13	0.8	98610	382	20835
13	WB	31.5	406	1	0.2	35344	21	11293
TOTAL	****	****	116998	18727	****	4574466	****	992830

Table 5 Gross Vehicle Weight by Class and Lane

<i>Vehicle Class</i>	<i>WB Driving Lane</i>	<i>WB Passing Lane</i>	<i>Total</i>	<i>Percentage</i>
1	0	2	2	0
2	941801	1404247	2346048	25.7
3	752794	955511	1708305	18.7
4	50389	27279	77668	0.9
5	167098	144051	311149	3.4
6	90920	30014	120935	1.3
7	68445	11099	79544	0.9
8	92417	30956	123373	1.4
9	2983030	929682	3912712	42.9
10	115888	54531	170419	1.9
11	116797	13856	130653	1.4
12	87799	11193	98992	1.1
13	30303	5062	35364	0.4
TOTAL	5497682	3617483	9115165	100
GVW/LANE	60.31	39.69	100	0

Table 6 ESALs by Class and Lane and Flexible ESAL Factors

<i>Vehicle Class</i>	<i>WB Driving Lane</i>	<i>WB Passing Lane</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
1	0	0	0	0	0.3333
2	117	290	407	0.5	0.0016
3	300	530	829	1	0.0069
4	705	562	1266	1.5	0.9
5	1700	1228	2927	3.5	0.26
6	1293	746	2038	2.4	1.03
7	1017	230	1247	1.5	1.68
8	1054	504	1557	1.9	0.76
9	39285	25819	65104	77.8	1.74
10	1342	1171	2513	3	1.7
11	2956	468	3424	4.1	3.28
12	1260	241	1502	1.8	1.9
13	698	131	829	1	3.99
TOTAL	51726	31918	83645	100	18
ESALS/LANE	61.8	38.2	100	-	-

Table 7 Site Summary: Volume and Vehicle Class

<i>Month</i>	<i>Total Volume</i>	<i>Monthly ADT</i>	<i>Monthly HCADT</i>	<i>Passenger Vehicles</i>	<i>Passenger Vehicles %</i>	<i>Heavy Commercial Vehicles</i>	<i>Heavy Commercial Vehicles %</i>
Sep 2019	1008591	33620	4586	871021	86.4	137569.5	13.6
Oct 2019	1016074	32777	4867	865184	85.1	150890	14.9
Nov 2019	889379	29646	4002	769306	86.5	120072.5	13.5
TOTAL	2914044	-	-	2505511	-	408532	-
AVERAGE	971348	32014	4485	835170	86	136177	14

###ESALS

<i>Month</i>	<i>ESALS WB Driving Lane</i>	<i>ESALS WB Passing Lane</i>	<i>Total ESALS</i>	<i>Pavement Life Decrease Months</i>
Sep 2019	57713	282452	340165	34.4
Oct 2019	93325	381848	475173	33.7
Nov 2019	52720	39396	92116	1.2
TOTAL	203759	-	-	-
AVERAGE	67920	234565	302485	23

###Gross Vehicle Weight

<i>Month</i>	<i>GVW WB Driving Lane</i>	<i>GVW WB Passing Lane</i>	<i>Total GVW Kips</i>
Sep 2019	5780096	4752543	10532640
Oct 2019	8992436	5775843	14768279
Nov 2019	5504682	3625854	9130535
TOTAL	20277214	14154240	34431453
AVERAGE	6759071	4718080	11477151

###Overweight Vehicles

<i>Month</i>	<i>Total Number of Overweight Vehicles</i>	<i>Overweight / Total Volume</i>	<i>Overweight / Heavy Commercial Volume</i>	<i>Number Over 88,000 lbs</i>	<i>Number Over 98,000 lbs</i>
Sep 2019	15331	1.6	11.1	2659	388
Oct 2019	20027	1.5	9.9	3313	478
Nov 2019	9152	1.1	7.8	3189	279
TOTAL	44510	-	-	9161	1145
AVERAGE	14836.7	1.4	9.6	3053.7	381.7

###Freight

<i>Month</i>	<i>WB Freight Tons</i>
Sep 2019	1169417

Oct 2019	1670063
Nov 2019	992830
TOTAL	3832310
AVERAGE	1277436.6
